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Efficacy and acceptability of psychological interventions for social anxiety disorder in children and adolescents: a meta-analysis of randomized controlled trials

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Abstract

Social anxiety disorder (SAD) is highly prevalent and persistent in children and adolescents. However, evidence for the efficacy and acceptability of psychological interventions for SAD in children and adolescents remains unclear. Seven electronic databases (PubMed, CENTRAL, Embase, Web of Science, PsycINFO, CINAHL, and ProQuest) were searched. Randomized controlled trials (RCTs) that compared psychological interventions for SAD with control conditions in children and adolescents were included. Primary outcomes were the efficacy (mean change in anxiety symptom scores) and acceptability (dropouts for all reasons). Secondary outcomes were remission, quality of life/functional improvement, and depressive symptoms measures. Seventeen RCTs were included in this meta-analysis. Psychological interventions (including cognitive behavioral therapy and behavioral therapy) were significantly more effective than control conditions, with a standardized mean difference (SMD) of -1.13 , and remission with a risk ratio (RR) of 8.99 , the number needed to treat was 3.3 . There was no statistically significant difference between psychological interventions and control conditions for all-cause dropouts (RR = 1.00). Psychological interventions were superior to control conditions in improving quality of life/functioning (SMD = 0.79) and reducing depressive symptoms (SMD = -0.39). Given considerable heterogeneity of primary efficacy outcome, a series of subgroup analyses of different variables were conducted. Psychological interventions are probably efficacious in the treatment of SAD among children and adolescents, and may markedly improve quality of life and functioning in this population. However, this finding should be interpreted with caution because of the high heterogeneity of trials and low literature quality.

Keywords Child · Adolescent · Psychological intervention · Meta-analysis · Social anxiety disorder

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Introduction

Social anxiety disorder (SAD) is a highly prevalent and persistent psychiatric disorder in children and adolescents and is associated with reduced social and scholastic functioning [1, 2]. SAD tends to develop early and has a lifetime prevalence of up to 10% in children and adolescents, with a low rate of naturally occurring recovery [1–3]. The symptoms of SAD in children and adolescents may differ from those in adults; children and adolescents may be more likely to blush, cry, cling, freeze, or have tantrums [4, 5]. SAD has a high frequency of comorbidity with other psychiatric disorders, such as other types of anxiety disorder, depressive disorder, and obsessive compulsive disorder [6–8]. Because of the atypical presentation and high frequency of comorbidities, SAD is often under-recognized in children and adolescents, meaning they do

not receive the treatment they need [6]. Moreover, there are increased rates of suicidal ideation, impaired social support, and seriously impaired school performance (e.g., poor school achievement and relational problems with family members and peer) among youth with SAD [3, 9]. The extent, impact, and long-term sequelae of SAD among children and adolescents highlight the need for effective interventions [10].

Various psychological interventions have been developed over the past few decades to decrease the burden on individuals with SAD, including cognitive therapy, exposure, social skills training, relaxation, and several different combinations of these [6]. Since the late of 1990s, a number of trials have examined the effects of psychological interventions for SAD in children and adolescents [11, 12]. Recently, a meta-analysis by Scaini found that cognitive behavioral therapy (CBT) showed a moderate to large effect size (0.99) when compared with control conditions for SAD in children and adolescents [13]. While, it only evaluated the efficacy of CBT for SAD in young patients, which including non-randomized and uncontrolled studies may have resulted in an over-estimation of the effects [13]. To evaluate the efficacy and acceptability of psychotherapy in children and adolescents with SAD, we conducted a meta-analysis by including different kinds of psychological intervention (e.g., CBT, behavioral therapy, psychodynamic therapy, exposure and social skills training). We want to examine whether psychological interventions are effective and acceptable for children and adolescents with SAD, and which psychological intervention is optimal. We also wanted to study which intervention format (individual, group, or individual and group combined; face-to face or internet-assisted; with or without parental involvement) is more effective for children and adolescents with SAD.

Methods

Data sources and searches

We conducted a meta-analysis of psychological interventions for SAD in children and adolescents based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses guidelines [14]. We searched seven electronic databases (PubMed, CENTRAL, Embase, Web of Science, CINAHL, PsycINFO and ProQuest) from inception to May 2017, using the key words: “social anxiety” or “social phobia,” “children” or “adolescents,” and “psychological intervention” or “psychotherapy.” Details of the search strategies are provided in Suppl. Table 1. Additional eligible randomized controlled trials (RCTs) were obtained by scanning the reference lists of identified articles and relevant review papers. No language restrictions were applied.

Study selection

Randomized controlled trials that compared a psychological intervention with a control condition among children and adolescents with SAD were identified. Two independent reviewers (LY and JP) reviewed potentially relevant articles to ensure selected studies satisfied the inclusion criteria: (1) any RCTs, including cross-over and cluster RCTs; (2) patients were aged ≤ 18 years when initially enrolled in the study; (3) patients with a primary clinical diagnosis of a current SAD according to standardized diagnostic criteria (e.g., Diagnostic and Statistical Manual of Mental Disorders, or the International Classification of Diseases); (4) manualized or structured psychological interventions including cognitive behavioral therapy (CBT), behavioral therapy (BT), psychodynamic therapy, exposure, social skills training, etc.; (5) comparison with a control condition including waitlist (WL), no-treatment (NT), treatment-as-usual, and psychological placebo (PBO). PBO was defined as an active psychological intervention that includes features common to most well-understood psychological therapies (i.e., non-specific components of treatment). Trials in which children/adolescents and adults were treated were eligible for inclusion if data for children/adolescents could be extracted separately or obtained from trial authors. Comorbidity with secondary medical or other mental health conditions (other types of anxiety disorder, depressive disorder, and attention deficit hyperactivity disorder) was not used as an exclusion criterion. However, we excluded RCTs that primarily aimed to treat comorbid conditions; trials of treatment-resistant SAD, because such participants are difficult to treat and their treatment response is different [15]; and trials with an overall sample size fewer than 10.

Outcome measures

The primary efficacy outcome was measured by mean change scores on anxiety symptoms in anxiety rating scales from baseline to post-intervention. These anxiety scales included the Social Phobia and Anxiety Inventory for Children [16], the Social Anxiety Scale [17], the Spence Children’s Anxiety Scale [18], and the Social Phobia Screening Questionnaire for Children up to 18 Years Old [19]. If anxiety symptoms were measured using more than one continuous scale in a trial, we chose the scale based on the frequency of use of that scale in this meta-analysis. The secondary outcome for efficacy was remission of anxiety diagnosis, which was measured by the proportion of patients who no longer met the diagnostic criteria for SAD at post-intervention [20]. The number

needed to treat (NNT) with 95% CIs was calculated [21]. The acceptability of the intervention was defined as all-cause dropout, measured by the proportion of participants who withdrew from the study for any reason up to the post-intervention.

We assessed quality of life/functional improvement (QoL/functioning) using the mean change score from baseline to post-intervention for validated scales (e.g., the Quality of Life Inventory, the Children's Global Assessment Scale). When both data were reported on quality of life and functional improvement, we preferred quality of life data.

We also assessed the efficacy of treatment for depressive symptoms, given the high frequency of comorbid depression. This was defined as the mean change scores in depressive symptoms from baseline to post-intervention.

Data extraction and quality assessment

Two independent researchers (LY, JP) extracted key characteristics of identified studies using a standardized data abstraction form, which included study characteristics (publication year, first author, journal, and country), patient characteristics (diagnostic criteria, age range, mean age, and sample size), intervention details (type of psychological intervention, intervention session, duration of intervention, intervention format, and type of control condition), and outcome measures (as outlined above). The risk of bias in identified studies was assessed using the Cochrane Handbook Risk of Bias Assessment Tool [22]. The criteria for rating study quality was: high risk study (3 or more items rated as high risk of bias); low risk study (5 or more items rated as low risk and no more than one as high risk); moderate risk study (all remaining situations) [23]. Any disagreements were discussed with a third reviewer (XZ).

Statistical analyses

We performed pairwise meta-analyses by synthesizing studies that compared the same interventions using the DerSimonian and Laird random-effects model [24, 25]. The effect sizes were expressed as standardized mean difference (SMD) with 95% confidence intervals (CI) for continuous outcomes, and risk ratios (RR) with 95% CIs for dichotomous outcomes. Significance was set at $p < 0.05$. Heterogeneity of intervention effects across studies was assessed by I^2 -squared and the p value of the Q statistic [26]. We used funnel plots to detect possible publication bias, and we also carried out Egger's regression asymmetry test to conclude whether there is significant publication bias [27]. We conducted subgroup analyses to examine whether effect estimates would be influenced by the type of intervention conditions, type of control conditions, intervention format, intervention program, parental involvement, age group, and sample size. We also

performed sensitivity analyses for primary outcomes (e.g., excluding those studies which were rated as "high risk of bias"). Missing dichotomous outcome data were managed according to the intention-to-treat (ITT) principle, and all the dropouts were considered as non-responders. Analyses were performed using Review Manager (RevMan) version 5.3 and Stata version 14.0 (StataCorp, College Station, Texas).

Results

Study selection and characteristics

In total, 17 parallel RCTs with 1134 participants published between 2000 and 2017 were included in this meta-analysis [28–44] (Fig. 1). Overall, 696 participants were randomized to psychological interventions (CBT, $n = 593$; BT, $n = 103$), and 438 participants were randomized to control conditions (WL, $n = 227$; NT, $n = 23$; PBO, $n = 188$).

The main clinical and demographic characteristics of included trials are summarized in Table 1. The mean sample size was 67 participants (range 12–138), the mean age of participants was 13.77 years (range 7–18 years), and more than half of participants (64.49%) were female. The number of intervention sessions ranged from 10 to 24, and one study used modules [39]. The total intervention duration ranged from 9 to 20 weeks. Only one RCT [37] did not report all-cause dropout.

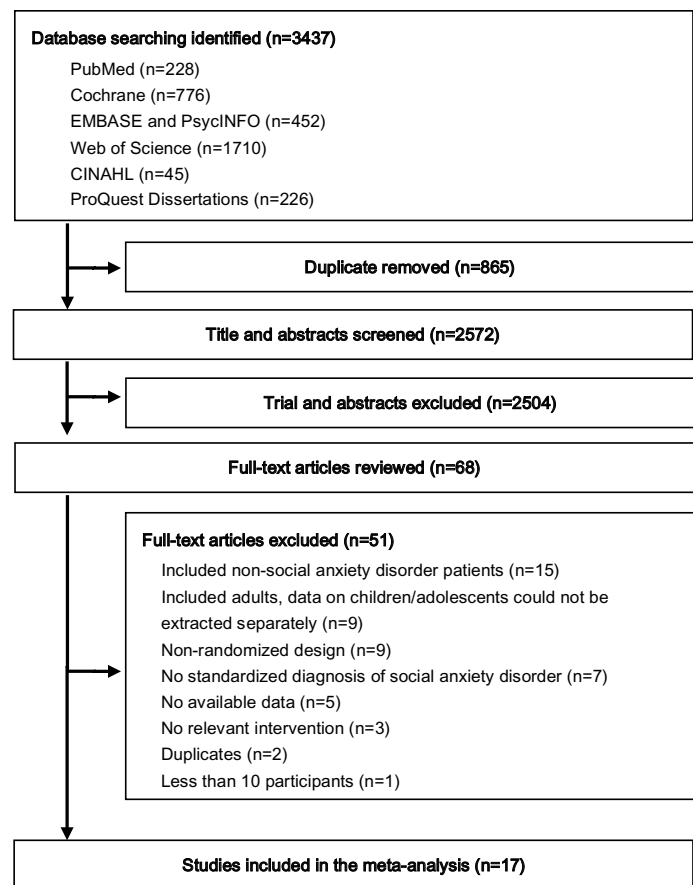
Efficacy outcomes

The overall pooled SMD in the primary efficacy outcome analysis showed a significant advantage of psychological interventions compared with control conditions, with a SMD of -1.13 (95% CI -1.59 to -0.68 ; $p < 0.001$) and very high heterogeneity ($I^2 = 89\%$, 95% CI 85–92%, $p < 0.001$) (Fig. 2a). The analysis of the secondary efficacy outcome showed a higher remission rate of psychological interventions than control conditions (39.14% vs. 3.20%; RR = 8.99; 95% CI 5.27–15.33; $p < 0.001$) with low heterogeneity ($I^2 = 0\%$, 95% CI 0–49%, $p = 0.82$; see Suppl. Figure 1), and the NNT was 3.3.

Acceptability outcomes

The acceptability outcome analysis indicated that 136 participants (136/639, 21.28%) in the intervention groups dropped out compared with 62 participants (62/413, 15.01%) in control conditions (Fig. 2b) with no statistical difference. The RR was 1.00 (95% CI 0.72–1.41; $p = 0.98$) with low heterogeneity ($I^2 = 19\%$, 95% CI 0–57%, $p = 0.24$).

Fig. 1 Flow chart of study selection



Quality of life/functioning outcomes

Psychological interventions showed a clear benefit in terms of QoL/functioning outcomes compared with control conditions (SMD = 0.79, 95% CI 0.41–1.17; $p < 0.001$), with high heterogeneity ($I^2 = 74\%$, 95% CI 40–85%, $p < 0.001$) (Fig. 3a).

Depression outcomes

Eight studies reported data for depression. Significant improvements were found, with a SMD of -0.39 (95% CI -0.63 to -0.16 ; $p = 0.001$) and low heterogeneity ($I^2 = 0\%$, 95% CI 0–56%, $p = 0.95$) (Fig. 3b).

Subgroup analyses

Because of the considerable heterogeneity of the primary efficacy outcome, we conducted a series of subgroup analyses of the primary efficacy outcome for different variables of studies to examine the possible sources of the heterogeneity, e.g., the type of intervention conditions (CBT or BT), type of control conditions (WL or other control conditions), intervention format (group, individual, individual

and group combined, or internet-assisted), intervention program (Intervention in Adolescents with Generalized Social Phobia [IAFS], Skills for Social and Academic Success [SASS], Social Effectiveness Training for Children [SET-C], or others), parental involvement (with or without), age group (mean age < 13 years or mean age ≥ 13 years), and sample size (≤ 50 or > 50 participants). The results of all the subgroup analyses are presented in Table 2 and Suppl. Figures 2–8.

Subgroup analysis which based on different control conditions showed a significant difference ($p = 0.02$). WL (SMD = -1.59 , 95% CI -2.33 to -0.86 ; $p < 0.001$) was significantly inferior to other control conditions, including PBO and NT (SMD = -0.65 , 95% CI -0.96 to -0.34 ; $p < 0.001$), see Suppl. Figure 3. Subgroup analysis based on different intervention program also showed significantly difference ($p < 0.001$). Studies with IAFS program (SMD = -2.68 , 95% CI -3.60 to -1.75 ; $p < 0.001$) had a significantly larger effect size than studies with SASS program (SMD = -0.52 , 95% CI -0.82 to -0.23 ; $p < 0.001$), SET-C program (SMD = -0.80 , 95% CI -1.19 to -0.41 ; $p < 0.001$) or others (SMD = -0.58 , 95% CI -0.85 to -0.30 ; $p < 0.001$), see Suppl. Figure 5.

Table 1 Characteristics of included trials

Trial	Num- ber of patients	Definition of SAD	Treatment comparators	Intervention program	Age range (mean)	Female (%)	Treatment duration (weeks)	Number of sessions	Anxiety scale	DO	Remission rate
Baer 2005	12	ADIS-IV C	I+G-BT=6 vs. WL=6	SET-C	13–18 (15.5)	7 (58.33%)	12	12	SPAI	1 vs. 0	4/6 vs. 0/6
Beidel 2000	67	ADIS-IV C	I+G-BT=36 vs. PBO=31	SET-C	8–12 (10.33)	34 (56.67%)	12	24	SPAI	6 vs. 11	20/36 vs. 1/31
Hayward 2000	35	ADIS-IV C/P	G-CBT=12 vs. NT=23	NA	14–17 (15.8)	35 (100%)	16	16	SPAI	1 vs. 1	5/12 vs. 1/23
Herbert 2009	73	ADIS-IV C	I-CBT=24 vs. G-CBT=23 vs. PBO=26	NA	12–17 (14.68)	41 (56.16%)	12	12	SPAI	7 vs. 7 vs. 7	NA
Ingul 2014	128	ADIS-IV C	I-CBT=36 vs. G-CBT=58 vs. PBO=34	NA	13–16 (14.50)	32 (56.14%)	12/10/10	12/10/10	SPAI	15 vs. 38 vs. 18	NA
Masia-Warner 2005	42	ADIS-IV C/P	G-CBT=21 vs. WL=21	SASS	13–17 (14.8)	26 (74.29%)	12	12	SPAI	3 vs. 4	12/21 vs. 1/21
Masia-Warner 2007	36	ADIS-IV C/P	G-CBT=19 vs. PBO=17	SASS	14–16 (15.1)	30 (83.33%)	12	12	SPAI	2 vs. 2	11/19 vs. 0/17
Masia-Warner 2016	138	ADIS-IV C/P	G-CBT=95 ^a vs. PBO=43	SASS	14–17 (15.42)	94 (68.12%)	12	12	SPAI	13 vs. 5	23/95 vs. 3/43
Melfsen 2011	44	DIPS-K	I-CBT=21 vs. WL=23	NA	8–14 (10.68)	21 (47.73%)	20/16	20	SPAI	6 vs. 2	6/21 vs. 0/23
Olivares 2005	34	ADIS-IV C	G-CBT=17 vs. WL=17	IAFS	14–17 (15.03)	20 (58.82%)	12	12	SPAI	0 vs. 0	10/17 vs. 0/17
Olivares 2014	117	ADIS-IV C	G-CBT=78 ^a vs. WL=39	IAFS	14–18 (15.42)	72 (65.45%)	12	12	SAS	3 vs. 4	31/78 vs. 0/39
Öst 2015	55	ADIS-IV C/P	I+G-BT=32 ^a vs. WL=23	SET-C	8–14 (11.6)	34 (61.82%)	12	24	SPAI	4 vs. 0	19/32 vs. 2/23
Rosa-Alcázar 2009	77	ADIS-IV C	G-CBT=20 vs. PBO=37 ^a vs. WL=20	IAFS	14–17 (14.87)	55 (71.43%)	12	12	SPAI	0 vs. 0	12/20 vs. 1/37 vs. 0/20
Sánchez- García 2009	82	ADIS-IV C/P	G-CBT=28 vs. G-BT=29 vs. WL=25	IAFS	10–14 (11.91)	60 (73.17%)	12	12	SPAI	NA	NA
Spence 2000	50	ADIS-III-R C/P	G-CBT=36 ^a vs. WL=14	NA	7–14 (10.68)	19 (38.00%)	12	12	SCAS	5 vs. 5	25/36 vs. 1/14
Spence 2017	125	ADIS-5 C/P	Int-CBT=95 ^a vs. WL=30	BRAVE- ONLINE	8–17 (11.28)	75 (60.00%)	10	10	SPAI	24 vs. 3	13/95 vs. 1/30

Table 1 (continued)

Trial	Num- ber of patients	Definition of SAD	Treatment comparators	Intervention program	Age range (mean)	Female (%)	Treatment duration (weeks)	Number of sessions	Anxiety scale	DO	Remission rate
Tiiffors 2011	19	SCID	Int-CBT = 10 vs. WL = 9	NA	15–21 ^b (16.5)	17 (89.47%)	9	9 module	SPSQ	1 vs. 0	NA

ADIS the anxiety disorders interview schedule, *DIPS-K* German version of the anxiety disorders interview schedule (*ADIS*) for children, *DO* dropout, *G-BT* group behavioral therapy, *G-CBT* group cognitive behavioral therapy, *IAFS* intervention in adolescents with generalized social phobia, *I-CBT* individual cognitive behavioral therapy, *I + G-BT* individual and group behavioral therapy, *Int-CBT* Internet-assisted cognitive behavioral therapy, *NT* no-treatment, *PBO* psychological placebo, *SAD* social anxiety disorder/social phobia, *SAS* Social Anxiety Scale, *SASS* skills for social and academic success, *SCAS* Spence Children's Anxiety Scale, *SCID* short version of the structured clinical interview for DSM-IV, *SET-C* social effectiveness training for children, *SPAI* Social Phobia and Anxiety Inventory for Children, *SPSQ* Social Phobia Screening Questionnaire, *WL* waitlist

^aCombined group

^bThe authors stated that only one patient was 21 years old

Sensitivity analyses

We performed a sensitivity analysis by excluding those studies which were rated as “high risk of bias”. The effect size was a little higher ($SMD = -1.22$, 95% CI -1.76 to -0.68 ; $p < 0.001$) with no change in the high heterogeneity ($I^2 = 91\%$, 95% CI 87–93%; $p < 0.001$), see Suppl. Figure 9.

In addition, according to the results of subgroup analyses, we performed a sensitivity analysis by excluding those studies which used IAFS intervention program. The effect size was much lower ($SMD = -0.58$, 95% CI -0.74 to -0.42 ; $p < 0.001$) with low heterogeneity ($I^2 = 0\%$, 95% CI 0–49%; $p = 0.494$), see Suppl. Figure 10.

Quality assessment and publication bias

The overall quality of the studies included in this meta-analysis was low to moderate, and some domains (e.g., sequence generation, incomplete outcome data and other potential bias) were assessed as high risk of bias (see Suppl. Figure 11). Concealment of random allocation from participants was not possible in psychological interventions or not mentioned in any of the studies. All studies use self-report outcomes.

The funnel plot for primary efficacy outcome could be seen in Suppl. Figure 12A, and the Egger test gave no indication of publication bias ($t = -1.63$, $p = 0.123$). The funnel plot for acceptability outcome could be seen in Suppl. Figure 12B, and the Egger test indicated the absence of publication bias too ($t = 0.69$, $p = 0.502$).

Discussion

To our knowledge, this is the first meta-analysis that synthesized RCTs on psychological interventions for children and adolescents with SAD. We found that SAD responds well to all available psychological interventions (including CBT and BT) in terms of social anxiety symptom reduction ($SMD = -1.13$) and SAD diagnosis remission ($RR = 8.99$) in children and adolescents. Our findings are consistent with previous studies [13, 45]. However, Scaini [13] only evaluated the efficacy of CBT for SAD in children and adolescents and included non-randomized and uncontrolled studies, which may have resulted in an over-estimation of the effects. In our meta-analysis, psychological interventions (including CBT and BT) were found to be effective for SAD in children and adolescents when limited to RCTs, and when eight new studies were included [13].

For the acceptability outcome, the rate of participants that withdrew from the studies was higher in the psychological intervention groups (21.28%) than among control groups (15.01%), but the difference was not statistically

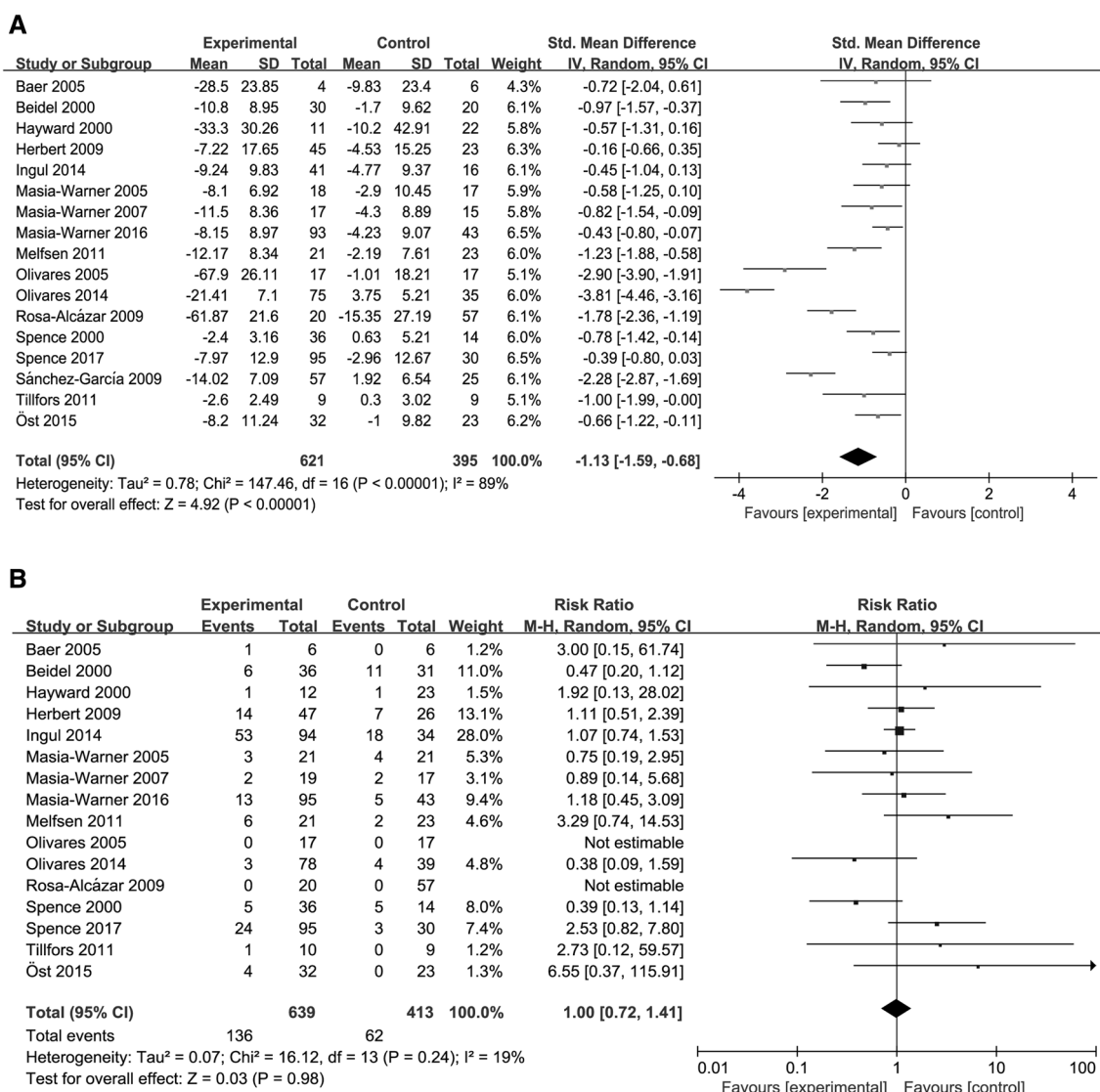


Fig. 2 Primary efficacy outcomes and acceptability outcomes. **a** Forest plot of the standardized mean difference (SMD) for change scores in anxiety rating scales. **b** Forest plot of risk ratios (with 95% confidence intervals) of dropout for any reason

significant. The higher dropout rate of CBT (125/565, 22.12%) than BT (11/74, 14.86%) appears to support the finding that young people experience more difficulty in sticking to interventions that emphasize cognitive changes [46].

Our study found that psychological interventions (including CBT and BT) markedly improved quality of life and functioning of children and adolescents with SAD. However, as some assessments of quality of life and functioning relied on patients' self-report and no overall quality of life and function scores were reported, these findings require confirmation. The results suggest that the treatment of SAD can also improve depression, which may mean that a specific intervention focus on depression in this population may not be needed. This finding is consistent with previous studies

in adults [47, 48], but require further confirmation due to the small number of relevant trials.

The high heterogeneity ($I^2 = 89\%$) for the primary outcome of our meta-analysis suggested possible systematic differences among the included studies. Our subgroup analyses indicated some possible sources of heterogeneity. First, our results showed that waitlist was inferior to other control conditions (including psychological placebo and no-treatment), which supported that the use of WL may affect the treatment effect of psychotherapy [46]. Second, subgroup analysis which based on different intervention programs showed a significant difference, and studies with IAFS program had an obviously larger effect size than studies with other programs. However, all of the IAFS programs were conducted by the same research group in a single center, and almost all the

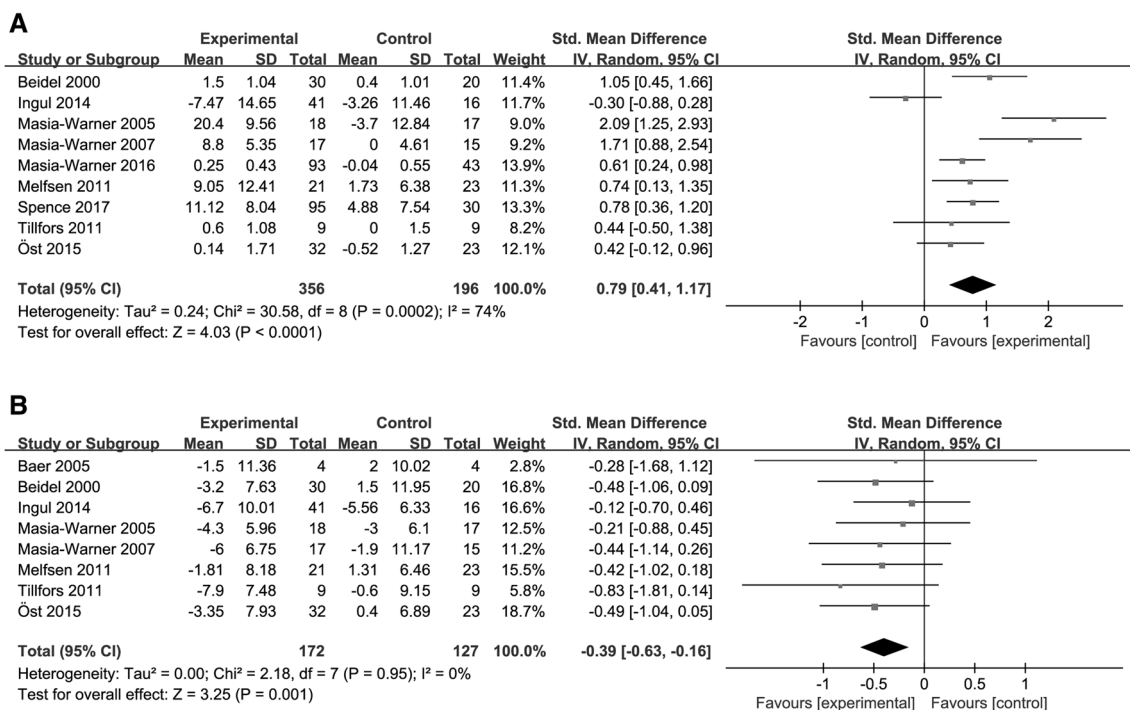


Fig. 3 Quality of life/functioning outcomes and depression outcomes. **a** Forest plot of standardized mean difference (SMD) for quality of life/functional improvement. **b** Forest plot of the SMD for depression outcome

participants of those studies were recruited from Murcia, Spain [41]. Due to the potential high risk of bias, this result should be interpreted with caution.

No differences were found between different types of psychological interventions (CBT or BT), which may support the idea that among different psychological intervention approaches, specific treatment components (i.e., social skills training) may contribute to the effective treatment of SAD [13, 28, 37]. Our findings are different from those among adults, with previous meta-analyses reporting that individual cognitive therapy may be associated with the largest effect sizes in adults [15, 49]. This may be explained by the concrete thinking, time-limited perceptions, egocentric nature of thinking, and different cognitive and emotional maturity levels in children and adolescents [4, 38]. However, as only two kinds of psychological interventions were included in this meta-analysis and the components of the interventions differed, these findings need to be confirmed in future RCTs.

Our subgroup analyses suggested that psychological interventions appeared to offer similar efficacy in individual, group, individual and group combined, and internet-assisted for children and adolescents. Group psychological intervention was associated with large effect size and may be more cost-effective. Thus, group psychological intervention was recommended for young patients with SAD. A large network meta-analysis recommended individual CBT as the best intervention for the initial treatment of adult SAD [50].

The difference between the previous meta-analysis [50] and our findings may be due to children and adolescents with SAD having poor social skills and marked fear or anxiety when individually participating in classroom activities and joining activities with peers [28]. The group intervention format may also provide opportunity for regular exposure to social situations and practice in social interactions skills with peers [28, 51].

Our study indicates that young patients can benefit from parental involvement in psychotherapy, while there is no clear evidence to support that psychotherapy with parental involvement was more effective than psychotherapy without parental involvement due to the relatively small number of studies. A possible explanation is that the parental involvement in the treatment of SAD young patients does not increase the psychotherapy effect unless there is a “disabling” relationship between the parent and the patient (e.g., parental over-control, over-protective, over-critical behavior, and parents reinforce anxious behavior in their children) [42].

There were some limitations in this meta-analysis. First, despite the increasing number of RCTs assessing psychotherapy for SAD in children and adolescents, only two kinds of psychological interventions were included in this meta-analysis (CBT and BT). Further research involving different kinds of psychotherapy with children and adolescents with SAD is needed. Second, there was

Table 2 Meta-analyses of studies examining the effects of psychological interventions on social anxiety disorder (with subgroup analyses), efficacy, acceptability, quality of life/functioning, and depression measures compared with control conditions: overall results and subgroup analyses

Characteristics	Number of contrast groups	SMD (or RR)	95% CI	I^2 (%)	95% CI	p value
Overall effects						
Primary efficacy outcome	17	−1.13	−1.59 to −0.68	89	85–92	<0.001
Secondary efficacy outcome	13	8.99	5.27 to 15.33	0	0–49	<0.001
Acceptability outcome	16	1.00	0.72 to 1.41	19	0–57	0.98
Quality of life/functioning outcome	9	0.79	0.41 to 1.17	74	40–85	<0.001
Depression outcome	8	−0.39	−0.63 to −0.16	0	0–56	0.001
Excluding high risk of bias	14	−1.22	−1.76 to −0.68	91	87–93	<0.001
Excluding IAFS	13	−0.58	−0.74 to −0.42	0	0–49	<0.001
Subgroup analyses						
Intervention group						
CBT	14	−1.19	−1.72 to −0.67	91	87–93	0.96
BT	4	−1.22	−2.06 to −0.38	81	26–91	
Control group						
WL	11	−1.59	−2.33 to −0.86	92	88–94	0.02
Others	7	−0.65	−0.96 to −0.34	52	0–78	
Intervention program						
IAFS	4	−2.68	−3.60 to −1.75	87	59–93	<0.001
SET-C	3	−0.80	−1.19 to −0.41	0	0–73	
SASS	3	−0.52	−0.82 to −0.23	0	0–73	
Others	7	−0.58	−0.85 to −0.30	30	0–70	
Intervention format						
Group	11	−1.19	−1.93 to −0.45	94	91–95	0.41
Individual	3	−1.10	−1.91 to −0.29	77	0–91	
Individual + group	3	−0.80	−1.19 to −0.41	0	0–73	
Internet-assisted	2	−0.52	−1.01 to −0.03	19	NA ^a	
Parental involvement						
With parental involvement	17	−1.13	−1.59 to −0.67	89	85–92	0.27
Without parental involvement	2	−0.75	−1.24 to −0.26	0	NA ^a	
Mean age						
< 13 years	6	−1.04	−1.59 to −0.49	82	57–90	0.73
≥ 13 years	11	−1.19	−1.87 to −0.51	92	87–94	
Sample size						
≤ 50 participants	9	−1.20	−1.89 to −0.50	94	91–95	0.70
> 50 participants	8	−1.04	−1.49 to −0.58	61	0–80	

BT behavioral therapy, CBT cognitive behavioral therapy, CI confidence intervals, IAFS intervention in adolescents with generalized social phobia, RR risk ratios, SASS skills for social and academic success, SET-C social effectiveness training for children, SMD standardized mean difference, WL waitlist

^aThe 95% CI of I^2 cannot be calculated when the number of studies is ≤ 2

considerable heterogeneity in this meta-analysis, although we conducted a series of subgroup analyses of variables of the studies, the results of this meta-analysis should be interpreted with caution because of this. Third, most trials compared treatment and control conditions without a

follow-up period. Further trials are needed to assess the effect of treatment with short- and long-term follow-up. Forth, risk of bias was considerably moderate to high in most of the included studies. Given all these, the results of our meta-analysis should be considered with caution.

Conclusion

The findings of this meta-analysis suggest that psychological interventions (including CBT and BT) are probably effective in treating SAD in children and adolescents, and can markedly improve the quality of life and functioning in this population. However, clinicians should interpret these findings carefully due to the limited amount of information, considerable heterogeneity and the low quality of evidence.

Author contributions LY and JP conceived the study. LY and JP drafted the manuscript. XZ and YZ assisted in the design and revision. LL and HZ participated in the search strategy development. SY and XJ designed the statistical analysis; PX and PC are the guarantors. The first four authors contributed equally to this study. All authors read and approved the final version of the manuscript.

Compliance with ethical standards

Conflict of interest The authors have declared that they have no conflicts of interest regarding the content of this article.

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